(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 030 778**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 80302722.6

(22) Date of filing: 08.08.80

(51) Int. Cl.^{3}: D 21 C 3/06
D 21 B 1/00

(30) Priority: 17.12.79 US 104668

(43) Date of publication of application:
24.06.81 Bulletin 81/25

(84) Designated Contracting States:
AT BE CH DE FR GB IT LI LU NL SE

(71) Applicant: THE ONTARIO PAPER COMPANY LIMITED
Allanburg Road
Thorold Ontario L2V3Z5(CA)

(72) Inventor: Barnet, Adrian John
16 Towering Heights Boulevard Apartment 508
St.Catharines Ontario(CA)

(72) Inventor: Shaw, Alan Caughey
142 River View Boulevard
St.Catharines Ontario(CA)

(72) Inventor: Logan, Charles Donald
9 Marlene Drive
St.Catharines Ontario(CA)

(74) Representative: Dew, Melvyn John et al,
Haseltine Lake & Co Hazlitt House 28 Southampton
Buildings Chancery Lane
London WC2A 1AT(GB)

(54) **Process for the formation of refiner pulp and refiner pulp prepared by the process.**

(57) Refiner mechanical pulp, in the form of RMP or TMP, of improved properties suitable for substitution for chemical pulp, especially in newsprint furnish, is obtained in a substantially pollutant-free process by subjecting the pulp, between the stages of refining, to chemical treatment using sodium sulphite solution to result in increased wet stretch and stress-strain properties while retaining high drainage and avoiding substantial yield loss. Strength properties of dried paper are enhanced and energy requirements to obtain improved pulp quality in the second stage of refining are less.

EP 0 030 778 A1

TITLE MODIFIED
see front page

IMPROVED PROCEDURE FOR FORMING REFINER PULPS

The present invention is directed to the formation of improved mechanical wood pulps useful for substitution for chemical pulps.

The term "mechanical pulp" as used herein has its normal meaning in the art and refers to the product of disruption of a woody substance by mechanical action to yield a product consisting mainly of liberated and separated single woody fibres and their fragments and which is suitable for use in the manufacture of paper.

The term "fibre" as used herein also has its normal meaning in the art and refers to individual plant cells which make up the woody material and which, in softwoods, are known botanically as parenchyma cells and tracheids. These fibres inherently have diameters generally below 0.05 mm and in the case of wood species commonly used in pulp formation and paper making, such as, spruce, balsam, pine, aspen and poplar, considerably below 0.05 mm.

"Refiner pulps" are a class of mechanical pulps formed by passing particulated cellulosic fibrous material, usually wood chips through a small gap between two ribbed parallel plates rotating with respect to each other (known as a disc refiner). The procedure may be effected at atmospheric pressure, the product being known as "refiner mechanical pulp" (RMP), or under pressure, typically about 1 to 2 atmospheres greater than atmospheric pressure, and at elevated temperature, such as, about 120°C, the product being known as "thermo-mechanical pulp" (TMP). The refining process usually is effected in two stages. In the first stage, the fibres are separated and liberated and in the second stage, additional refining energy is supplied to increase the fibre flexibility and conformability, fibrillation and bonding. Usually about half the overall refining energy of about 100 to about 120 horsepower-days per ton is applied to the fibre-liberation stage.

Because mechanical wood pulps can be made in yields over 95% with minimal pollution problems, there is strong incentive to increase their usage in paper manufacture. In general, however, it is not possible to transport a sheet, formed entirely of mechanical pulp, at high speed through the forming, pressing, drying and reeling sections of the paper making machine, without an unacceptable number of breaks. Chemical pulp is usually added to the furnish to improve its machine runnability. Traditionally newsprint is manufactured from a furnish consisting of about three parts groundwood or other mechanical pulp and one part chemical pulp.

"Runability" refers to that combination of properties which allows the wet web to be transported at high speed through the forming, pressing and drying sections of the paper making machine and allows the dry sheet to be reeled and printed with not more than an acceptable number of breaks. In effect, runability is a measure of the efficiency with which the paper passes through the paper machine and printing press.

The chemical pulp component is usually manufactured by the kraft or sulphite process in yields ranging from about 45 to 65%. Chemical pulps are expensive, make heavy demands on the mills wood resources, and entail formidable pollution problems. As already noted, mechanical wood pulps are obtained in yields in excess of 95% with minimal pollution problems.

Despite all the disadvantages associated with the use of chemical pulps, they are generally employed in making newsprint because runability is the key to paper making machine and press-room efficiency, which in turn is the key to profitability.

In accordance with this invention, there is provided a process for the formation of an improved refiner pulp which is suitable for use as a replacement for chemical pulps in many applications, including newsprint furnish.

The process of this invention results in an increase in the elongation to rupture (hereinafter known as "wet stretch") and an improvement in the stress-strain properties of the wet web formed from the pulp, while simultaneously maintaining rapid drainage. We have discovered a hitherto unknown phenomenon that high wet stretch and high wet stress-strain characteristics, in combination with rapid drainage, are the fundamental pulp properties which improve the runability of a newsprint furnish.

The fibre-to-fibre bonding within a dry paper sheet formed from the pulp produced by the process of the invention is improved, thereby resulting in the desirable properties of increased tensile and burst strengths and increased sheet density.

One important feature of this invention is that there is formed a refiner pulp which can be used as a substitute, in whole or in part, for chemical pulp in many of its applications and which results from a procedure which does not produce more than insignificant quantities of polluting effluents, in complete contrast to chemical pulping procedures,where large quantities of polluting effluents must be handled. The overall energy requirements of the refining operation to provide a predetermined level of pulp quality also are decreased, as compared with the conventional refiner pulp-formation operation.

The process of the invention comprises three steps, namely (a) subjecting particulated cellulosic fibrous material to mechanical action in a disc refiner to form a pulp consisting mainly of single fibres and fragments thereof, (b) chemical reaction of the pulp with a soluble salt of sulfurous acid under certain precise elevated temperature and pressure conditions as detailed below, and (c) subjecting the chemically-treated pulp to mechanical action to refine the same and improve the pulp quality.

The cellulosic fibrous material species and refining conditions required to manufacture a usable mechanical pulp are well known to the art. For example, it is well known that most hardwoods cannot be refined to yield mechanical pulps with adequate strengths. Application of the invention is restricted to refiner pulps which are generated from softwoods, or other cellulosic fibrous material species which are recognized in the industry as being suitable for the preparation of refiner pulps. The invention is described further with particular reference to wood species.

The three individual steps comprising the process of the invention are discussed separately below:

STEP (a) Fibre Separation

A wood fibre consists essentially of a cell wall, whose outer surface is made up of cellulose-rich fibrillar layers known as the S_1 and S_2 layers. In wood, the space between the fibres, known as the middle lamellae, is filled with a lignin-rich material.

The process of the invention requires that, in the initial liberation of the fibre from the wood in a disc refiner, the fracture occurs mainly in the S_1 and S_2 layers, thus exposing the cellulose-rich fibrillar material which is the source of the fibrillation characteristic of a good mechanical pulp. Since this fibre morphology is established at the moment of fibre liberation, it is necessary that the process of fibre liberation proceed largely to completion. Therefore, the product of the initial mechanical fibre separation step of the process of the invention must consist mainly of single wood fibres, which inherently have average diameters less than 0.05 mm. More than the minimum energy to accomplish this separation may be applied, but is unnecessary.

It is well known that, in thermomechanical pulping, if the refining temperature exceeds the thermal softening point of lignin, fibre separation occurs in the middle lamellae to yield a smooth fibre with a lignin-rich surface. This fibre is difficult or impossible to fibrillate by further refining and is generally unsuitable for use as a mechanical pulp. Hence the initial fibre separation step in this invention is effected at a temperature below the thermal softening point of lignin. The latter temperature is variable with the wood species, duration of heating and refining conditions, but is generally below about 150°C.

Attempts have been made to decrease the energy required for fibre separation and improve pulp quality by a chemical softening of the wood prior to refining. Such a process, using sulphite as the treating chemical, is disclosed in U.S. Patent No. 4,116,758. The products of the latter process are smooth walled fibres showing little tendency to fibrillation, similar to those described above resulting from refining above the lignin softening temperature, and are unsuitable for use as a mechanical pulp in this invention.

It is within the scope of this invention, however, to add the chemicals required in the subsequent treatment step to the wood chips prior to their entering the disc refiner, provided that the temperature and time of contact is such that no substantial reaction occurs and no significant chemical softening of the chips results. The disc refiner acts as an efficient mixer of the pulp and chemicals at the high consistency normally encountered.

It is also within the scope of the invention to subject the wood chips, prior to refining, to steam under pressure at a temperature below the thermal softening temperature of the lignin, typically below about 140°C in accordance with conventional industrial practice in TMP manufacture.

A product of step (a), suitable for further treatment in accordance with this invention, is obtainable simply by following the first stage refining procedures well known to the art, for the production of a good mechanical pulp. This is usually accomplished by presteaming wood chips, usually at a temperature of about 120° to about 135°C and 1 to 2 atmospheres pressure for 2 to 10 minutes, then passing the presteamed wood chips, which have not been softened by chemical action, through a disc refiner at a temperature below the thermal softening temperature of the lignin, and applying sufficient refining energy to yield a mechanical wood pulp consisting mostly of single fibres and their fragments, such fibres and fragments being predominantly below 0.05 mm in average diameter. This operation is generally effected at a consistency of about 10 to about 40% by weight, usually about 25 to 30% by weight.

STEP (b) Chemical Reaction

After the required physical form of the wood fibre is obtained in step (a), the chemical nature of the fibre is modified by reaction with an aqueous solution of a soluble salt of sulphurous acid, usually sodium sulphite. The reaction is effected at temperatures above about 110°C under a superatmospheric pressure for a time sufficient to yield a chemically-treated mechanical wood pulp capable of forming a paper web having improved wet stretch and stress-strain properties and exhibiting rapid drainage, but for a time insufficient to cause substantial dissolution of lignin with consequent loss of yield and generation of polluting effluents. The exact nature of the chemical reactions involved in the chemical treatment effected in this invention are not fully understood, but are thought to involve sulphonation.

During the reaction, the pH of the solution drops and alkali is consumed. It is essential to the process of the present invention that sufficient alkali be present in the chemical charge to prevent a pH drop below 3 during treatment, otherwise there is a risk of damaging the fibres through hydrolytic action with consequent loss of strength. The exact amount of alkali required varies according to the acetyl content of the wood supply and cannot be specified exactly, but is readily established by experimentation.

The alkali requirement may be met entirely with sodium sulphite. However, since only half of the sodium of sodium sulphite is available for neutralization, it is usually more economical to meet part of the alkali requirements by additions of sodium hydroxide or sodium carbonate. The pH of the mixture, however, is preferably kept below about 12 because hemicelluloses are dissolved from wood fibre by higher pH's, with consequent loss in yield.

In a preferred embodiment of the invention, the amount of sodium sulphite used in the chemical treatment is in the range of about 4% to about 15% by weight based on the mechanical wood pulp resulting from step (a), although lower concentrations down to about 1% by weight may be used with reduced beneficial effect, with the provision that the residual sulphite content of the mixture, as measured iodimetrically, does not fall substantially to zero before termination of the reaction. Below 1% by weight of sodium sulphite,improvements are too small to justify the expense of treatment. Similarly improvements are observed with chemical charges up to about 25% by weight of the pulp, but the additional cost is not justified by the small additional improvement. Generally, therefore, a chemical charge of between about 1% and about 25% by weight, preferably between about 4% and about 15% by weight, of the mechanical pulp, is used. The chemical charge preferably has a pH between about 7 and about 12, and contains sodium sulphite and sufficient alkali to maintain a pH greater than 3 throughout the reaction.

The reactions of sulphite with wood are known to consist of a large number of different reactions, whose rates are dependent on reaction conditions, particularly pH and temperature. The present state of our knowledge of this complex subject has been summarized by G. Gellerstedt in Svensk Papperstidning nr. 16, 1976, p. 537 to 543. It has been established that the reactions necessary for the application of the process of the invention and the results attained thereby are those that proceed at pH's greater than 3 and preferably over 7, and at temperatures over about 110°C, and preferably over about 130°C. Other reactions of woody substances with sulphite which proceed at lower pH's and at temperatures below 100°C are known, such as those described by H.J. Kvisgaard in Norsk Skogindustri 19, no. 4, 1965, p.155-163. Such reactions, however, are not effective to produce an improvement in wet and dry properties, in fibre flexibility and consolidation and in power requirements, such as is contemplated in this invention.

We have found that the maximum improvement, namely, maximum increase in wet stretch, maximum improvement in stress-strain, maximum increase in strength characteristics, and maximum decrease in refiner power requirements for the second stage (step (c) discussed below), is obtained from the process of the invention when the mechanical pulp from step (a) with added chemical is heated at about 160°C for 30 minutes. As with any other chemical reaction, the temperature can be lowered if the reaction time is increased. Below about 120°C, reaction time becomes impractically long, and below 110°C, the required reactions effectively cease. Similarly, the reaction temperature can be increased if the reaction time is shortened. The practical upper limit of temperature appears to be about 200°C with reaction times of 1 to 2 minutes. We prefer not to operate under these extreme conditions because the precise control of conditions and reaction times needed to achieve an optimum product are difficult to secure.

It is also possible to operate at shorter or longer than the optimum reaction times to produce a less than optimum but still useful result. If the reaction time is shorter than optimum, the improvements in wet stretch, stress-strain and strength properties and energy requirements are less than may be otherwise obtained by operating under optimum conditions. If the reaction time is too long, substantial dissolution of the lignin from the pulp, in the treating chemical occurs, with consequent loss of yield and formation of polluting effluent. While the process is still operable to produce property improvements under these conditions some of the advantages of wood economy and low pollution are lost and generally are avoided.

The chemical treatment is operable over a time-temperature range from about 110°C for about 12 hours to about 200°C for about 1 minute. It is understood that an increase in temperature must be accompanied by a concomittant decrease in reaction time. For example, the process is not operable at a temperature of 200°C for 12 hours. To derive maximum benefits from the chemical treatment step, it is preferred to operate in the more limited range of about 130°C for about 2 hours to about 180°C for about 15 minutes.

Because of uncertainties in specifying the exact upper limits of the chemical treatment step in terms of time and temperature, it is considered more useful and precise to specify the upper limit in terms of the effect of the chemical treatment on pulp yield therefrom. Reaction conditions which decrease the yield, based on mechanical wood pulp, below about 85% are outside the scope of our process, since wood losses and the pollution capability of the spent aqueous phase become significant and intolerable beyond this limit. It is preferred to select maximum reaction conditions such that the yield of treated pulp is greater than about 90%. The exact conditions required vary with wood species, chemical charge and consistency, but will fall within the limits of time and temperature as defined above, and are easily established by experimentation.

The chemical reaction which is effected in step (b) on the mechanical wood pulp resulting from step (a) is quite distinct from the methods used in the pulping of woody substances with sulphite or bisulphite to form chemical pulp. In sulphite pulping, heat and chemical are supplied to the woody material in chip form (i.e., fibre bundles) by circulating hot cooking liquor through a bed of the woody material. With the mechanical pulp produced in step (a) of the process of the invention, the resistance to flow of liquor is so great that circulation of liquor therethrough is impractical. In consequence, all of the chemical required to effect the reaction of step (b) must be incorporated in the pulp when it enters the reactor. It is advantageous to incorporate the chemical in solution in a volume of water which can be totally absorbed by the pulp. In practice this means that the consistency after chemical addition normally should be above about 15% by weight. Consistencies below about 50% by weight are preferred because it is easier to secure uniform mixing of chemical and pulp below that level. The consistency range of about 15% to about 50% by weight, therefore, is preferred for reasons of convenience, but the operability of the process is not limited by consistency.

The chemical treatment step in the process of the invention is also distinguished from chemical pulping processes in that the process of the invention cannot be conducted practically in a batch process, such as is used in chemical pulping. This is because the thermal insulating properties of the mechanical pulp are so high that a large pulp mass cannot be heated to reaction temperature by conduction in a reasonable length of time. The chemical treatment may be carried out batch-wise using dielectric or microwave heating techniques but such methods are expensive. It is preferred to carry out the chemical reaction step in an apparatus wherein pulp is continuously raised to reaction temperature and introduced into one end of a reaction vessel of such size as to provide the desired reaction duration, while treated pulp is removed simultaneously from the other end.

Step (c) Refining

In the third, and final, step of the process of the invention, the product of step (c) is subjected to further refining action in a disc refiner, following the usual practice of the industry for second stage refining of a mechanical wood pulp. The results of this second refining action differ from those obtained with an ordinary mechanical wood pulp because the application of steps (a) and (b) in accordance with this invention places the pulp in the required physical and chemical configuration to utilize further refining energy efficiently and economically. It is well known that the quality of a mechanical wood pulp can be improved by increased refining, but at a cost of slower drainage and increased energy demand. The product of step (b) may be refined to equivalent quality with significantly less energy, while achieving a faster drainage, as compared to mechanical pulp from step (a) which has not been subjected to step (b). These results are illustrated graphically in Figure 1, in which a measure of pulp quality is plotted against refining power for two cases. The measure of pulp quality employed was the tensile strength of the wet web, measured at 5% wet stretch to eliminate the effects of pulp latency. Similar plots are obtained using such other measures of pulp quality as breaking length or burst factor.

Point A in Figure 1 defines the state of the pulp at the completion of step (a) of the process of the invention. Point B represents the same pulp after completion of step (b). The line B-C gives the properties of the pulps derived from step (b) by the application of varying amounts of refining energy in accordance with step (c) of the process of the invention. The line A-D represents the properties of pulps obtained by directly refining the product of step (a), without the application of step (b). The dramatic effect of the chemical treatment of step (b) in improving the drainage of refined pulp, as measured by Canadian Standard Freeness (C.S.F.), in increasing the pulp strength, and in decreasing the energy requirements in the application of the refining of step (c) is clearly evident from the graphical representation of Figure 1.

The consistencies employed in the application of step (c) may be varied over the range normally employed in the second stage refining of a mechanical wood pulp, but the properties of the product depend to some extent on the refining consistency chosen. Higher consistencies over about 20% by weight yield products with higher wet stretch while lower consistencies tend to produce pulps with higher strength. By adjustments in refining consistency, the desired balance between wet stretch and strength for a particular application can be achieved. For most applications, it is preferred to carry out the refining step (c) at consistencies between about 1% and about 35% by weight.

The amount of energy applied in step (c) may be varied according to the desired properties of the product and the intended end use. The degree of refining to which the pulp is subjected is usually controlled by the freeness of the finished pulp. For most applications, this freeness should fall within the range of about 50 to about 700 C.S.F. For example, boxboard stock is typically of higher freeness than magazine grade paper stock. For newsprint application, it is preferred to refine to a freeness in the range about 100 to about 400 C.S.F. in step (c).

The invention is illustrated by the following Examples:

Example 1

Spruce chips were pre-steamed for 25 minutes at 35 psig and fed to a 1000 HP Sprout-Waldron 36 ICP refiner under the following conditions:

Throughput: 25.0 tons per day
Discharge consistency: 25 - 30%
Specific energy: 45 horsepower-days per ton

The pulp from the pressurized refiner, consisting mainly of single fibers, and substantially free of particles greater than 0.05 mm in diameter, was divided in three portions. One portion was mixed with 10% by weight of sodium sulphite at pH 9 and heated at 18% consistency at 90°C for 1 hour. Another portion was mixed with 10% sodium sulphite at pH 7 and heated at 18% consistency and 160°C under a pressure of 75 psig for 1 hour. A third portion was untreated. Each portion was then refined further in a 12 inch Sprout-Waldron open discharge refiner at 18% consistency and a specific energy input at 63 horsepower-days per ton. All three pulps thus received a total of 113 horsepower-days per ton of refining energy.

The usual practice in mechanical pulping is to remove latency prior to screening, cleaning and final use. This procedure was explained by L. R. Beath, M. T. Neill and F. A. Masse in an article entitled "Latency in Mechanical Pulps", Pulp and Paper Magazine of Canada 67 (10)T423(1966). To correspond to this common industrial practice, latency was removed from our pulps by treatment at 90°C for 15 minutes, prior to testing. The properties of these pulps are compared in the following Table I:

TABLE I

Treatment	None	90°C	160°C
Yield, %	100	98	93
Freeness	194	197	80
Drainage, sec.	0.83	0.93	2.16
Wet tensile, N/m	62	63	75
Wet stretch, %	3.3	3.7	5.3
Wet caliper, mm	0.344	0.353	0.302
Bulk	2.68	2.57	2.12
Burst	16	17	23
Breaking Length	3100	3300	5100

Using the same total refining power, the untreated sample and the sample treated at 90°C refined to essentially the same freeness with insignificant differences in wet and dry properties. By contrast, the sample treated at 160°C refined to lower freeness with the same power, yielding over 60% increases in wet stretch and breaking length, as well as significant increases in wet tensile strength and burst. The drainage rate is much faster than an untreated TMP of similar quality.

The wet caliper and bulk are measures of the fiber's ability to consolidate in the paper sheet. The low values obtained with the pulp treated at 160°C are indicative of a flexible fiber which consolidates well to form a dense, coherent sheet.

Example 2

A TMP prepared in a pressurized refiner as described in Example 1 was mixed with 10% sodium sulphite at pH 9.0 and heated at 18% consistency at 160°C and 75 psig for 1 hour. Samples of the treated and untreated TMP were then refined to comparable freeness levels, and the pulp properties measured after latency removal at 90°C for 15 minutes. Power consumptions and the corresponding pulp properties are outlined in the following Table II:

TABLE II

	Untreated	Treated	Untreated	Treated
Power, HPD/T	126	101	101	82
Freeness	107	118	305	331
Drainage, sec.	1.27	1.63	0.66	0.83
Wet tensile, N/m	58	77	59	76
Wet stretch, %	4.0	5.1	3.3	4.3
Wet caliper, mm	0.322	0.290	0.385	0.326
Bulk	2.47	1.92	3.14	2.08
Burst	14	28	14	32
Breaking Length	3200	5600	2800	5800
Yield, %	100	94	100	96

These data show, that by treatment according to the process of the invention, power requirements to reach a desired freeness and drainage target can be reduced over 20%. In addition these power savings are accompanied by substantial improvements in wet web properties, in dry strengths, and in fiber consolidation.

Example 3

Southern pine pulp from the pressurized first stage refiner of a commercial newsprint mill was treated at 145°C for 1 hour with 10% by weight of sodium sulphite at pH 9. The resulting pulp was then refined at power inputs of 19 and 38 horsepower-days per ton in a 12 inch Sprout-Waldron refiner.

The untreated pulp was refined in a like manner. The properties of these products after delatency treatment at 90°C for 15 minutes, are listed in the following Table III:

TABLE III

	Untreated	Treated	
Refining Power, HPD/T	38	19	38
Freeness, C.S.F.	194	243	146
Drainage, sec.	0.64	0.65	0.82
Wet tensile, N/m	36	42	46
Wet stretch, %	4.4	5.4	5.9
Caliper, mm	0.402	0.375	0.348
Bulk	3.65	2.74	2.56
Burst	9	19	20
Breaking length	2100	3400	3800
Tear	67	92	89

These data illustrate the application of the process of the invention to a difficult species; southern pine has a stiffer, thicker fiber than spruce and in general yields a lower quality TMP. However by application of the process of the invention, a product of equal or better quality to that conventionally obtained can be made, with the following added advantages.

1) Less power is needed to reach equal freeness.

2) At equal power inputs, the treated pulp refined to lower freeness, with large improvements in both wet and dry properties. Burst and breaking length are approximately doubled.

3) At half the second stage power input and higher freeness, the treated product is still superior to the product derived from untreated TMP.

4) The process of the invention results in major improvements in fiber consolidation as shown by the decrease in wet caliper and bulk.

Example 4

Spruce chips were refined in a Bauer 420 open discharge refiner at a rate of 65 tons per day and a specific energy of 60 horsepower-days per ton. One portion of this RMP was mixed with 10% sodium sulphite at pH 9 and heated at 145°C and 50 psi pressure for one hour. Both treated and untreated pulps were further refined in a 12-inch Sprout-Waldron refiner at 20% consistency. The resulting RMP's had the properties outlined in the following Table IV, after latency removal at 90°C for 15 minutes.

TABLE IV

	Untreated		Treated	
Secondary Refining Power				
HPD/T	0	45	45	32
Freeness, C.S.F.	388	122	81	156
Drainage, sec.	0.61	1.16	2.3	1.28
Wet Web Properties				
Tensile, N/m	36	56	63	68
Stretch, %	3.2	4.3	5.6	4.7
Caliper, mm	0.454	0.336	0.287	0.311
Dry Properties				
Bulk	3.98	2.70	1.98	2.22
Burst	8	16	23	25
Breaking Length	1700	3300	4900	4700
Stretch	1.2	1.8	1.7	1.9
Tear	61	66	52	69

This example illustrates several points. The RMP from the primary refiner (first column) requires additional application of refining power for the development of adequate properties. The application of a further 45 horsepower-days per ton of refining power results in the greatly improved properties listed in column 2. However application of the same amount of power to an RMP which has been treated according to the present invention results in a product with lower freeness and superior wet and dry properties (column 3). Alternatively by application of only 32 horsepower days per ton of additional refining power, a pulp is produced with comparable freeness and drainage characteristics but significantly improved in all wet and dry properties, shown in column 4.

This illustrates that the process of the invention is applicable to refiner mechanical pulps as well as thermo-mechanical pulp.

In summary of this disclosure, the present invention is directed to the formation of an improved mechanical pulp which can be used as a substitute for chemical pulp. Modifications are possible within the scope of this invention.

CLAIMS:

1. A process for the formation of refiner pulp having improved properties, which comprises the steps of (a) subjecting wood chips which have not been softened by chemical action to mechanical action in a disc refiner at a temperature below the thermal softening temperature of lignin to cause the formation of a mechanical wood pulp consisting mainly of single wood fibres and fragments thereof; (b) treating the pulp at an elevated temperature above 110°C and under a superatmospheric pressure with an aqueous solution of a soluble salt of sulfurous acid containing sufficient alkali to maintain a pH greater than 3 during the treatment, such treatment being effected at a temperature and for a time to enable reaction with the pulp to occur and to produce a chemically-treated pulp capable of forming a paper web having increased wet stretch and improved stress-strain properties while rapid drainage is retained, such treatment being effected at a temperature and for a time insufficient to result in a treated pulp yield below 85% by weight; and (c) subjecting the chemically-treated pulp to mechanical action in a disc refiner to improve the pulp quality of the same to provide a refined pulp having a Canadian Standard Freeness of 50 to 700.

2. A process as claimed in claim 1, in which the soluble salt of sulfurous acid is an aqueous sodium sulphite solution and the treatment step (b) is effected at a pulp consistency of 4 to 15% by weight and at an applied chemical charge of 1 to 25% by weight of sodium sulphite based on pulp.

3. A process as claimed in claim 2, in which the sodium sulphite solution has an initial pH of about 9 to about 12.

4. A process as claimed in any one of claims 1 to 3, in which the aqueous solution of a soluble salt of sulfurous acid is added to the wood chips prior to passage of the latter through the disc refiner in step (a), so that the aqueous solution is intermixed with the fibres as they are formed.

5. A process as claimed in any one of claims 1 to 4, in which the treatment step (b) is effected at a temperature of 130°C for 2 hours to 180°C for 15 minutes, the temperature and time of treatment being effected to maintain the yield above 90% by weight.

6. A process as claimed in any one of claims 1 to 5, in which the wood chips are subjected to steaming at a temperature of 120° to 135°C under 1 to 2 atmospheres pressure prior to step (a).

7. A process as claimed in any one of claims 1 to 6, in which step (a) is effected at a consistency of 10 to 40% by weight.

8. A process as claimed in any one of claims 1 to 7, in which the mechanical pulp resulting from step (a) consists mainly of single wood fibres and fragments thereof of diameter less than 0.05 mm.

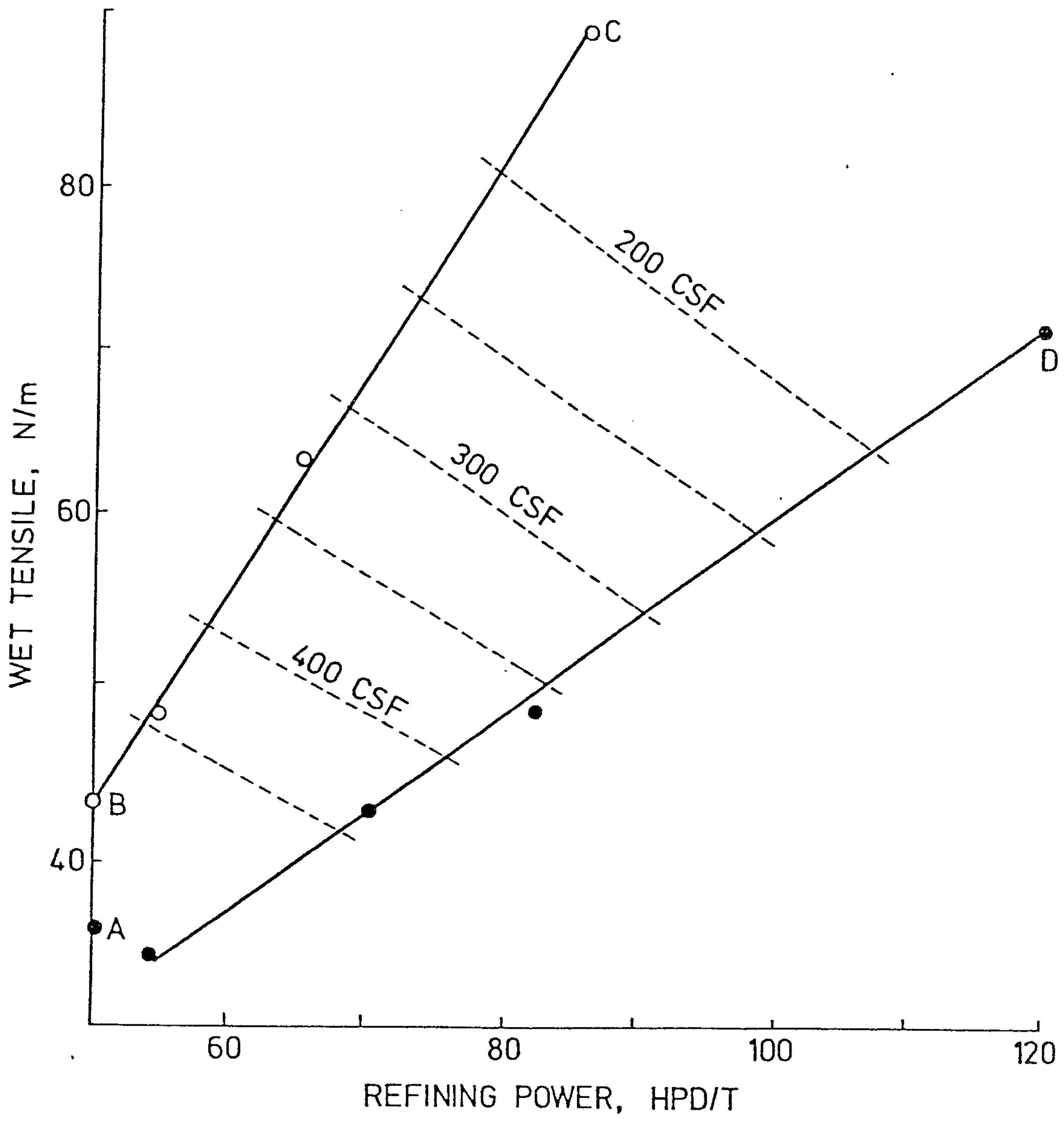
9. A process as claimed in any one of claims 1 to 8, in which step (a) is effected under an elevated temperature below the thermal softening temperature of lignin and under a superatmospheric pressure.

10. A process as claimed in any one of claims 1 to 9, in which step (c) is effected at a consistency of 1 to 35% by weight.

11. A process as claimed in any one of claims 1 to 10, in which step (c) is effected to provide a refiner mechanical pulp of a Canadian Standard Freeness of 100 to 400 C.S.F.

12. A process for the formation of refiner pulp substantially as hereinbefore described with reference to any one of the Examples.

13. Refiner pulp whenever prepared by a process as claimed in any one of claims 1 to 12.



WET TENSILE, N/m
80
60
40
C
B
A
D
200 CSF
300 CSF
400 CSF
60
80
100
120
REFINING POWER, HPD/T

FIG. 1

0030778

European Patent Office

EUROPEAN SEARCH REPORT

Application number
EP 80 30 2722

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
X	US - A - 4 145 246 (D.W. GOHEEN et al.) * Entire document , in particular examples 2,3 * ----	1-4,6, 8,10-12

CLASSIFICATION OF THE APPLICATION (Int. Cl.3)

D 21 C 3/06
D 21 B 1/00

TECHNICAL FIELDS SEARCHED (Int. Cl.3)

D 21 C 3/06

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	25-02-1981	NESTBY

EPO Form 1503.1 06.78